BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : A63F 9/12 — A1

(11) International Publication Number: WO 91/00758

(43) International Publication Date: 24 January 1991 (24.01.91)

(21) International Application Number: PCT/AU90/00297

(22) International Filing Date: 9 July 1990 (09.07.90)

(30) Priority data:

PJ 5166	7 July 1989 (07.07.89)	AU
PJ 9850	30 April 1990 (30.04.90)	AU

(71)(72) Applicant and Inventor: ALLAN, Ralph, Wylie [AU/AU]; 12 Kanangra Street, Redbank Plains, QLD 4300 (AU).

(74) Agent: PIZZEY & COMPANY; Level 6 Trustee House, 444 Queen Street, Brisbane, QLD 4000 (AU).

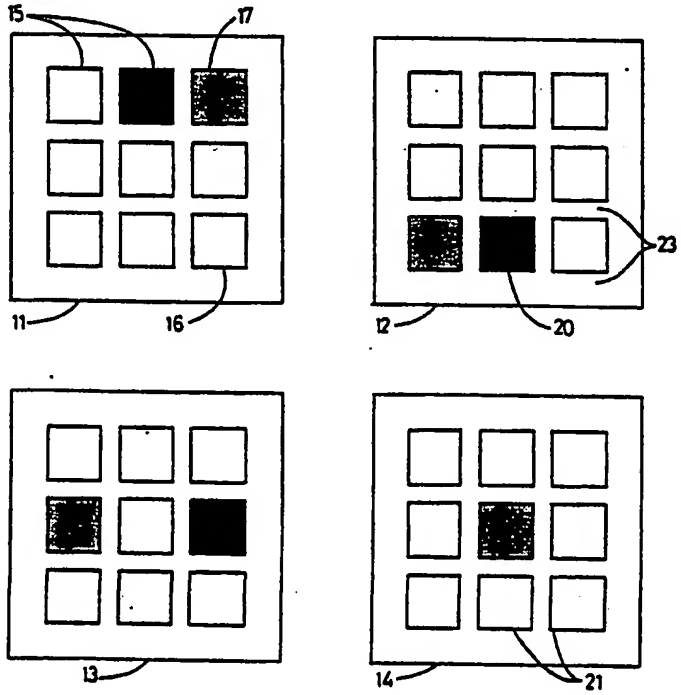
(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CM (OAPI patent), DE*, DE (European patent)*, DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC, MG, ML (OAPI patent), MR (OAPI patent), MW, NL, NL (European patent), NO, RO, SD, SE, SE (European patent), SN (OAPI patent), SU, TD (OAPI patent), TG (OAPI patent), US.

Published
With international search report.

(54) Title: A PUZZLE

(57) Abstract

A multi-layered puzzle is provided comprising two or more separate or separable puzzle layers (11, 12, 13, 14). Each layer includes one or more pattern portions (16) on one or both sides of the layers and one or more apertures (21) formed through the layers such that pattern portions formed on one or more of the puzzle layers may be viewed simultaneously. One each layer, the pattern portions and the apertures are variously arranged within a framework (23) such that when the layers are overlaid in the one or more correct relative orientations and/or sequences a composite pattern or picture is formed.



* See back of page

DESIGNATIONS OF "DE"

Until further notice, any designation of "DE" in any international application whose international filing date is prior to October 3, 1990, shall have effect in the territory of the Federal Republic of Germany with the exception of the territory of the former German Democratic Republic.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	ES	Spain	MC	Monaco
AU	Australia	FI	Finland	MG	Madagascar
BB	Barbados	FR	France	ML	Mali
BE	Belgium	GA	Gabon	MR	Mauritania
BF	Burkina Faso	GB	United Kingdom	MW	Malawi
BG	Bulgaria	GR	Greece	NL	Netherlands
BJ	Benin	HU	Hungary	NO	Norway
BR	Brazil	IT	Italy	RO	Romania
CA	Canada	JP	Japan	SD	Sudan
CF	Central African Republic	KP	Democratic People's Republic of Korea	SE	Sweden
CG	Congo			SN	Senegal
CH	Switzerland	KR	Republic of Korea	SU	Soviet Union
CM	Cameroon	LI	Liechtenstein	TD	Chad
DE	Germany, Federal Republic of	LK	Sri Lanka	TG	Togo
DK	Denmark	LU	Luxembourg	US	United States of America

A PUZZLE

This invention relates to a puzzle.

This invention has particular but not exclusive application to puzzles for amusement, and for illustrative purposes reference will be made to such application. However, it is to be understood that this invention could be used in other applications, such as puzzles having advertising or educational uses.

Puzzles can be entertaining and may improve the cognitive powers of regular users. Many puzzles, such as the Rubik's Cube, are mechanical assemblages containing moving parts which must interact to operate the puzzle. These moving parts add to the cost of producing them, as well as reducing their reliability in use.

Plain puzzles of the solitaire or competitive kind are also known. For example, US Patent No. 4362301 discloses a method of making a puzzle, which method codifies a number of images onto an equal number of partial image sheets so that by the proper arrangement and registry of the sheets any of the individual images can be reproduced. Many such puzzles involve overlaying layers made of some transparent material with partial images, variously distributed on different layers. The disadvantage of such puzzles lies in the fact that the partial images are located on the layers in locations which are non-standardised between different layers, leading to difficulties of production.

The present invention aims to alleviate the above disadvantages and to provide puzzle apparatus which will be reliable and efficient in use. Other objects and advantages of this invention will hereinafter become apparent.

With the foregoing and other objects in view, this invention in one aspect resides broadly in puzzle apparatus including a plurality of puzzle elements each having a plurality of symmetrically arranged segments whereby the elements may be selectively grouped with the segments aligned and characterised in that each element has an array of indicia in respective ones of said segments whereby at least one grouping of elements may be effected with the indicia cooperating to form a predetermined pattern.

For the purposes of this specification, the term

"pattern" is to be taken to refer to any pattern, picture or other organised graphical or textual representation.

Each of the puzzle elements may take any form consistent with its function of bearing a symmetrical array of segments which in turn may bear indicia of a type capable of forming a selected pattern. For example, the puzzle elements may be made in any size, shape and thickness in both two and three dimensions. For example, the elements may be:-

(i) Substantially two dimensional, such as square, rectangular, triangular, circular or polygonal layers; or

(ii) Three dimensional, such as cubic, part cubic, spherical, semi-spherical, convex or concave surfaces.

In the case of three dimensional puzzles, the elements in any particular set may be of different sizes to facilitate their fitting together in overlay.

Preferably, for ease of manufacture and simplicity in use, the puzzle elements are relatively thin, flat puzzle layers. The layers may be of any suitable material such as wood, plastic, paper, cardboard, glass, metal or the like.

Puzzle layers are preferably constructed such that all layers in a particular stack of layers are of the same shape and external dimensions for ease of manufacture and use. Preferably, the the shape of the layers is selected from symmetrical plane shapes such as squares, circles, triangles or any other polygonal shape. The selection of a symmetrical shape is preferred to provide a number of plane orientations of a layer which permit superimposition with other layers of the puzzle but only one of which orientations is correct.

A minimum of two layers may be used to overlay on each other to form combined patterns. The number of layers which can be in principle overlaid on each other is infinitely large. In practice, the number of layers to be overlaid on each other preferably ranges between three and ten. Depending on the construction of the puzzle, from one to a very large (even infinite) number of different combined patterns may emerge from different combinations of orientation in overlay.

Puzzles may be constructed which consist of two or

more stacks of layers which must be placed adjacent to each other to form some larger pattern or picture. Layers may be patterned such that patterned portions from more than one part of the overall picture are on one or both sides of layers within a particular stack and a layer or layers from one stack may be successfully combined with layers from other stacks to produce parts of the overall solution pattern or patterns. In this way, the level of difficulty and challenge of the puzzle may be varied.

Preferably, and to best achieve coincidence in overlay as well as to facilitate assembly of a number of stacks, the layers may be symmetrically shaped with their sides being equilateral, for example, square or any other equal sided symmetrical polygon. Whilst layers need not necessarily have this feature, symmetry is preferred to provide scope for more interesting and challenging puzzles.

Preferably, layers are wholly overlaid on each other such that the puzzle assembly conforms to the shape of individual layers whatever relative orientation of the layers is chosen.

The segments of the puzzle elements may take any form consistent with their being arranged symmetrically on the puzzle element. The segments may be of any shape and size consistent with the dimensions of the layer. The segments on a particular layer may be of differing shapes and sizes or, preferably, of the same shape and size. Between layers, the segments would preferably be located such that when two or more layers within a particular set are overlaid, segments of the same shape and size on the various layers coincide whatever relative orientation of the layers may be chosen. This is most simply achieved where all segments are of the same size and shape.

The segments on each layer may be of any shape, size or patterning and arranged within any symmetrical framework. For example, the segments may be square, triangular, circular, polygonal or any other suitable shape. Different sized and shaped portions, may be included on any one layer.

Preferably, the segments are of the same shape as the layer.

The array of indicia may take any form consistent

with the function of being capable of regenerating one or more predetermined patterns upon selection of one or more particular relative orientations of the puzzle elements. Preferably, the indicia take the form of pattern portions and look-through portions disposed on the puzzle elements. The look-through portions are preferably selected from the group comprising apertures provided in the puzzle elements and transparent windows provided in the puzzle elements.

The indicia may be wholly contiguous with their respective segments or may occupy a portion thereof whereby there remains a framework or lattice separating the indicia. The framework or lattice may itself be overprinted or otherwise made consistent with the puzzle solution. Alternatively, the segments may be defined by frameworks such as thin plastic frames which are not printed on but are not wide enough to disrupt the general continuity of the formed puzzle.

The pattern portions may be of any colour or colours, shaded, contain symbols, shapes, letters, numbers, pictures, parts of bigger pictures, or any combination thereof. Different pattern portions on the same layer may be differently or similarly patterned. In addition to or instead of any of the above arrangements, semi-transparent pattern portions may be used for all or some pattern portions. When overlaid, the effect of an opaque pattern portion covered by one or more semi-transparent ones, or of two semi-transparent portions, may be a distinct pattern arising from the combination. For example, a blue semi-transparent over a yellow one may result in a green combined pattern.

Preferably, each layer comprises one or more opaque pattern portions of a pre-determined solution pattern on one or both sides of the layer.

The relative disposition and number of opaque portions to apertures in general determines whether a particular apparatus requires the layers to be placed in a certain order or orders to be solved, or is independent of the order of the layers chosen.

The opaque portions may serve to contain the pattern portions and also serve to obscure pattern portions and/or

apertures on lower layers of a stack of puzzle layers whereby the difficulty of a puzzle may be varied. Selected opaque portions may be patterned in a manner incompatible with the pre-determined pattern and accordingly must be obscured by compatible pattern portions on a higher layer or layers of the puzzle apparatus. Such an arrangement may serve to ensure that the order of adding layers is a necessary factor in achieving the desired pattern.

The predetermined pattern may include an array of geometric shapes, and may include variations in position and/or colour such that the pre-determined pattern may attain a degree of complication sufficient to render the puzzle challenging to a user. The pattern may also or instead include pictorial matter whereby a picture may be formed by overlaying selected layers.

In the manner described above, a large, almost infinite, number of differently patterned and configured individual puzzles may be constructed using the essential features of the invention.

In this context, two basic types of pattern portion can be distinguished. On the one hand, the patterning of pattern portions may be such that any particular pattern in a portion gives no guide within itself as to its appropriate orientation or its appropriate combination with another portion on a different layer for example, pattern portions consisting only of a single patch of colour. Alternatively, the pattern of a portion may comprise elements which in and of themselves contain guides as to the appropriate orientation of the layer and appropriate combinations with other layers, for example, portions of a scene of people on a beach.

In the first case, the method of forming the puzzle involves the selection and combination of layers through a process of trial and error and logical relationship of their various configurations of opaque and aperture portions and patterning with each other and with the desired solution pattern. In the second case, similar processes are involved but in addition the solution of the puzzle may be aided by the identification of the correct orientation of a layer from features on opaque patterned portions.

Accordingly, in a further aspect, this invention resides in a method of forming a puzzle, including:-

providing a plurality of puzzle layers, selected ones of which include portions of a pattern, and further selected ones of which include apertures or transparent portions whereby a puzzle assembly of said puzzle layers in a particular order and/or orientation may produce a predetermined pattern or picture from the pattern portions visible from one side of the puzzle assembly.

If desired, patterns or portions thereof may be formed on one or both sides of selected puzzle layers, and may be arranged to be assembled independently or simultaneously by manipulation of the puzzle layers.

In a further aspect of the present invention the layers may be represented visually by electronic means on a screen such as a video display terminal, television or the like, and computer programs may be written to provide screen representations of the various layers.

In a further aspect, this invention resides broadly in a method for producing a puzzle of the type claimed in any one of the preceding Claims and including the steps of:-

selecting a puzzle solution;

selecting a desired shape and number of puzzle elements between 3 and 10 inclusive;

dividing said elements into an array of segments each having the same shape as said elements;

providing a look-through aperture through each of a random selection of segments of a first element;

providing those segments not occupied by said apertures with a corresponding portion of the pattern of said solution;

overlaying said first element over said solution, and

progressively assigning segments on successive elements to contain patterned portions or apertures such that, in assembly, said elements display said solution pattern.

If limitation of the number of possible solutions is desired, it may be desirable to test all possible combinations of the layers to identify possible solutions. There may be one or more possible combinations that produce the desired pattern. Upon determining the solutions to a puzzle, it may be desirable to accept or adjust

configurations and retry depending on satisfaction with the outcome.

The production of sequenced layer puzzles may take into account, amongst other things, the following principles, particularly if it is desired to limit the number of possible solutions:-

(i) Compatible top layer - The configuration and patterning of at least one side of one layer must be compatible, in at least one of its orientations, with the configuration and patterning of the pre-determined combined pattern. One such layer may be used as the top layer of the set.

(ii)Method of sequencing - On each layer below the top layer, sequencing may be achieved by including at least one pattern portion which is incompatible in patterning with the desired pre-determined combined pattern. The pattern portion may be incompatible in all orientations of the layer or only some.

By structuring the set from the top down the location of the incompatible pattern portion can be chosen so that it will be covered by a compatible pattern portion on a higher layer. Sequencing is based on the principle that incompatible pattern portions must be covered by compatible portions on higher layers. At the limit, puzzles may be constructed so that the total number of compatible opaque pattern portions on the various layers equals the total number required in the pre-determined pattern, and, apart from the top layer, each successive layer, in addition, has only one incompatible pattern portion.

Naturally, a puzzle may also be such as to have more than the required total number of opaque compatible pattern portions on the various layers and more than one sequencing pattern portion on each layer. To help to restrict the number of possible solutions when producing sequenced layer puzzles, it is desirable to ensure that:-

(i) an incompatible pattern portion (given that the other pattern portions on the layer match the specified combined pattern) is covered by a compatible pattern portion on the layer intended to be immediately above it;

(ii) particularly where only one incompatible pattern

portion is to be used on each layer, no single compatible pattern portion covers incompatible pattern portions on more than one appropriately orientated layers.

That is, it is desirable to place incompatible pattern portions in different locations on the various layers relative to the appropriate orientation of the various layers. If there are more than one inconsistent pattern portions, the other ones may be covered by an appropriate component picture portion on any higher layer.

As indicated previously, there are a variety of methods of construction of the various layers and they may be made in a wide variety of preferably symmetrical shapes and sizes and from a wide variety of materials. Pattern and aperture portions can also be placed in a wide variety of relative configurations (including differing numbers of pattern portions on the layers in particular sets or stacks) provided that they may fit in overlay with sufficient other appropriate layers to form the desired pattern or picture.

In one embodiment of the present invention, layers intended to be in different stacks within the same puzzle may be of appropriately differing various symmetrical shapes and relative sizes such that the resulting stacks are of different shapes, the shapes being complementary such that the stacks may be interlocked in assembly to form the correct solution.

A straightforward, inexpensive and preferred version would consist however of layers of the same size and shape with the pattern and apertures portions variously arranged within a standard framework.

Where the puzzle is of the type where a plurality of stacks are to be solved and then assembled into an overall puzzle solution in the manner of a jigsaw type puzzle, the layers may be configured such that the appropriate layers must be overlaid in one or a restricted number of sequences using similar approaches to those outlined above. For example, layers other than those intended to be the top layers, may include one or more portions in certain locations which contain a component picture or pattern portion inconsistent with the desired picture part. To avoid such portions being seen they must be covered by appropriate

component picture portions on a higher layer.

The inconsistent picture portions may be of any pattern or picture element which does not fit the intended solution picture when the layer is in its correct orientation. Thus, inconsistent picture portions may also include picture portions from any one of the solution picture parts provided that in the correct orientation of the layer it does not match the picture to be constructed and therefore must be obscured. This could include even an picture portion which is in its correct location but is rotated through 90 or 180 degrees relative to the compatible picture portions on the same layer so that details, for example, lines and colours, do not correspond with continuations of these details on immediately adjacent portions of overlaid layers.

Layers may be excluded from being on the top by placing an image in the frame areas of the layer which is inconsistent with at least some of the picture portions. In addition, puzzles using two-sided layers may be provided so that the user may construct either one only overall picture or pattern or two alternative overall patterns.

In addition, two-sided layers may be provided so that the user may construct one of two alternative solution pictures or patterns. One side of each layer may contain component pattern portions necessary to construct parts of one of the patterns or pictures, and the other side of each layer may contain component pattern or picture portions necessary to construct parts of the other pattern or picture.

Alternatively, for a sequenced layer puzzle many, but not all, individual layers may have on each side component picture or pattern portions of both pictures or patterns placed thereon such that to form one of the solution pictures incompatible pattern or picture portions must be obscured by compatible ones on higher layers arranged in an appropriate sequence. Depending on which picture is in fact being solved, pattern portions on a particular side may be regarded as potential picture components or incompatible portions which must be obscured by compatible segments on higher layers.

A double sided puzzle may have many, but not all, individual layers having on each side component picture

portions of both pictures. The solution in this case would require that higher level layers are placed in overlay such that incompatible image components on lower layers will be obscured. The layer intended to be the top one in any sub-set must have component picture portions on one of its sides from only one of the pictures parts.

In a two-sided layer approach used for the construction of a single picture solution where multiple stacks are used, a range of other approaches may be used to add further variety and/or difficulty to the puzzle. For example, each layer in a subset may have component picture portions from the same part of the picture on the rear so that, in a three layer puzzle for example, the user may select from 6 sides located on only three layers to solve the puzzle. Alternatively, each layer in a sub-set may have component picture portions from the same part of the picture on the rear, but different to that on the front, in a matching pair arrangement.

Thus layers with component picture portions from a single part on side A may each have component picture portions from another part, and layers with component picture portions from that other part on side A would have the first part component picture portions on side B. (Note the distinction of side A and B is for illustrative purposes only.) Thus, in a three layer puzzle, for a particular part of the solution picture, there would be 6 possible layers and 6 of 12 layer sides from which to choose 3 layers to form the part of the overall picture in question.

When one part is formed, the other three layers must of necessity be able to be combined to form the other part.

Further, each layer in a subset may have component picture portions from a single different part of the picture on side B and that different part is further matched, when on side A with a yet further part on side B. Thus, a puzzle part on side A of a layer may be matched with a second part on side B. However, when the second part appears on side A of another layer it has some other part than the first part on side B.

This can be expressed algebraically as follows. If there are two sides, side A and side B , side A for one

subset of layers may have component picture portions from part X of the overall picture and on side B may have component picture portions from part Y. For another subset where part Y may be regarded as appearing on side A, the component picture portions on side B must be from part X+N where X+N is less than or equal to the total number of parts and N is a positive or negative integer and part X+N has not already been used on sides A and B in two other subsets of layers.

Puzzle layers may be so configured that it is possible to solve a first stack of the puzzle and a second stack of the puzzle but not be unable to solve a third stack because some of the necessary sides are underneath the first and second stacks. The solution of the puzzle may require one of the former two parts to be solved using other available layers so as to free up sufficient layers for the solution of the third stack.

Alternatively, each layer in a particular stack may have on the sides A, component picture portions to form one stack, but on the sides B, each such layer may have component picture portions from different stacks.

In yet another alternative, where on one side of each layer, component picture portions are compatible with the solution picture, on the other side of each layer, some or all of the component picture portions may contain picture portions which are incongruous with the overall solution picture. Thus only one side of a layer so treated would may able to be used in the solution of the puzzle.

Such incongruous segments can be produced in many ways. For example, component picture portions, a number of component picture portions or indeed the whole side of the puzzle on side B may be printed as a mirror image of the image on side A so that prima facie it looks suitable but in matching with component picture portions on other layers is in fact incompatible. Alternatively, correct individual component picture portions may be used in some or all of the portions on side B but placed in relative positions to other individual component picture portions and the solution picture such that the layer will not match the solution picture in any of its orientations.

In other embodiments, component picture portions may be rotated through 90 or 180 degrees relative to other component picture portions on the same side of the layer, or component picture portions may be included from a picture or pattern other than the solution picture. Puzzles may also include any combination of the abovedescribed features.

In order that this invention may be more easily understood and put into practical effect, reference will now be made to the accompanying drawings which illustrate a preferred embodiment of the invention, wherein:-

FIG. 1 is a plan view of the layers according to the invention;

FIG. 2 is a plan view of an assembled puzzle comprising the layers shown in FIG. 1;

FIG. 3 is a plan view of a symmetrical triangular shaped puzzle layer according to the invention;

FIG. 4 is a plan view of a symmetrical circular shaped layer puzzle according to the invention;

FIG. 5 is a plan view of a symmetrical 3-Dimensional layer according to the invention;

FIG. 6 is a plan view of a four part puzzle according to the invention;

FIG. 7 is a plan view of the four part puzzle of FIG. 6, illustrating an alternate solution pattern;

FIG. 8 is a plan view illustrating the configuration of one of the layers of the puzzle of FIG. 7;

FIG. 9 is a plan view of a further picture puzzle according to the invention;

FIG. 10 is a plan view of a possible configuration of the puzzle of FIG. 9;

FIG. 11 is a plan view of a layer according to the invention and suitable for use in the puzzle of FIG. 9, and

FIG. 12 is a plan view of a preferred layer according to the invention suitable for use in the puzzle in Fig. 9.

In the embodiment illustrated in FIGS. 1 and 2 there is provided a puzzle 10 comprising four square layers 11, 12, 13 and 14, each of which has a pattern of nine squares 15 formed on its surface. Each of the nine squares are of the same size, and each array of nine squares are arranged in the same symmetrical framework. Selected ones of the squares 15

are pattern portions, comprising blue squares 16, orange squares 17 and yellow squares 20, the selection of each of the squares for coloring being dependent on the puzzle solution intended. In this embodiment, the remaining uncoloured squares 15 are transparent windows or apertures 21.

Each of the squares 15 containing pattern portions is similarly patterned on the reverse side of the layer. Thus for example, the blue square 16 is blue on its reverse side, the orange square 17 is orange on its reverse side and so on.

In this particular embodiment the arrangement of coloured squares and apertures leaves a lattice 23 which may be opaque or transparent.

In use, the puzzle is solved by superimposing the layers 11, 12, 13 and 14. The relative positions of the layers in the stack of layers and the orientation of each of the layers relative to the other layers determines the correct solution.

In the case of the embodiment of FIGS. 1 and 2, the assembled puzzle 22 is assembled by overlaying layer 12 on layer 11 then further overlaying layers 13 and 14 in the orientations shown in Fig. 1. In the process, the yellow squares 20 on layers 11, 12 and 13 are covered by blue squares 16 on layers 12, 13 and 14 respectively, ensuring that the layers 11, 12, 13, and 14 will produce the desired blue-and-orange pattern only if they are overlaid in the correct order as described.

In the embodiment of Figs. 3 and 4 there are illustrated examples of the variation which can be introduced in the symmetry of the layers to provide alternate puzzles to those illustrated in Figs. 1 and 2. For example, Fig. 3 illustrates a triangular layer having triangular pattern and/or aperture portions 24, as may be used in a puzzle analogous to that illustrated in Figs. 1 and 2. In this embodiment the triangular layer is of equilateral shape to provide the maximum symmetry and thereby the maximum puzzle difficulty for a triangular geometric shape. Similarly, to ensure that maximum difficulty is achieved geometrically, the apertures and/or patterned portions should also be equilateral.

Fig. 4 illustrates a plane circular layer for use in a puzzle, which of course would have an infinite number of axes of symmetry in its plane. Layers such as a circular layer may advantageously be provided with circular apertures and/or patterned portions of equal size 25 or unequal size 26 depending on the degree of difficulty to be introduced in the puzzle by means of purely geometric qualities.

Fig. 5 illustrates a further embodiment of the present invention wherein the layers are not planar, such as part spherical or other curved shape, in this case having square apertures 18 and pattern portions 19.

Another embodiment of the invention is shown in FIGS. 6 to 8. FIG. 6 illustrates a puzzle comprising four contiguous sets 27 of layers overlaid five layers deep, comprising in total twenty layers. Fig. 6 illustrates one solution pattern achievable when the layers are correctly overlaid and combined in four adjacent stacks or parts. Fig. 7 illustrates another solution pattern achievable using the same twenty layers arranged in a different combination. The configuration of each layer in Fig. 6 is shown by the numbers 28 in the various squares. Thus layer bearing the numeral 11 in FIG. 6 has opaque patterned portions marked by the number 11. All the other squares indicated in FIG. 6 by numbers other than 11 are, on the '11' layer , aperture squares or transparent portions. The '11' layer is shown in FIG. 8 for comparison.

In FIG. 6, opaque patterned portions or squares are red 29, green 30 or blue 31. The same convention is used in FIGS. 7 and 8. This particular example is such that the layers in any of the four stacks when correctly overlaid to provide the pattern in FIGS. 6 or 7 may be in any order top to bottom and the total number of opaque patterned squares on each of the five layers in the overlay equals the total number of squares or portions on any one layer.

To form the pattern in FIG. 7 after having formed that in Fig. 6, the particular combination of layers combined in any one stack or part of the overall pattern differs. Thus, in the top left hand part of FIG. 6 layers 14, 16, 18, 19 and 20 are used whereas in the same part in FIG. 7 layers 8, 13, 14, 15 and 16 are combined.

Fig. 9 illustrates a further embodiment of the present invention, which has similarities to a jig-saw puzzle in that component parts must be correctly combined to form a picture or logical pattern. FIG. 9 illustrates a picture puzzle which is divided in 6 parts 32 a, b, c, d, e and f as shown. The letters in brackets show the picture parts 6 which are printed on the rear of each layer in the set. Each part 32 consists of a set of layers (in this example three layers deep) correctly overlaid to form the solution picture part.

In use, the various parts are placed in appropriately contiguous positions to form the overall picture. The solution picture is solved by identifying from the 18 available double-sided layers which layers and which sides of these layers form the picture portions in each part of the picture. A guide picture showing the desired picture to be formed may be provided for reference as is done with a jig-saw puzzle. Naturally, the picture can be divided into any number of parts 32 and the number of layers to be overlaid in any one part can be any number equal to or greater than two provided the configuration of the layers is compatible with the required depth of overlaying.

FIG. 10 provides an example of a set of individual layers 33 of a puzzle such as that illustrated in Fig. 9, in this case constituting a puzzle in which the sets of layers can be overlaid in any order top to bottom. FIG. 10 illustrates the configuration of the eighteen layers 33 each viewed from one major face and arranged in sets of three. The picture portions are represented by the shaded portions 34 and the aperture portions by the unshaded portions 35.

The layers 33 in each set of three are shown with the picture portions 34 in their correct orientation relative to each other and the solution picture so as to form the picture parts 32 shown in FIG. 9. The directions of the arrows 36 indicate the orientation of the picture portions on the rear of each set of three layers. That is, a part 32 of the overall solution picture is printed on the rear of the layers such that for layers (i), (ii) and (iii) in FIG. 10, the top portion of the picture part on the rear is at the left hand edge of the layers is viewed so that the layers would have to

be flipped over and turned through 90 degrees for the picture part on the rear to be upright.

The picture part 32 printed on the rear of layers (i), (ii) and (iii) is part (f) as shown in FIG. 9. The lower case letters in parenthesis are used to indicate the reverse side of the puzzle layers.

In this particular example, each set of layers when correctly formed can be turned over to display another picture part correctly formed. Thus to form any picture part 32, the user must choose three layers from six possible layers to form the correct solution. For example to form picture part (a) an appropriate combination (in this case there are several) must be made from layers (i),(ii) and (iii) as viewed in Fig. 10 and the rear sides of layers (xiii), (xiv), and (xv).

Two embodiments of the individual layers are shown in FIG. 11 and FIG. 12.

Fig. 11 shows three picture portions 37 placed or printed on a transparent material 38 which provides a structural base for the layer and enables overlaid picture portions on other layers to be viewed simultaneously. The dotted lines 39 do not appear on the layers but demonstrate how picture and transparent portions on layers in a set are effectively placed in a consistent symmetrical framework.

Fig. 12 shows an embodiment which features apertures 40 cut through the layer 41. This leaves a frame 42 on which relevant sections of the picture part 32 may be printed in order to provide continuity of the picture between picture portions 43 and sets of layers in the overall puzzle. The picture portions 43 visible in overlay through aperture portions 40 on other layers are shown within the dotted lines 44. The dotted lines are shown for illustrative purposes only and would not form part of an actual puzzle.

This embodiment has the advantage that it can be produced relatively inexpensively and easily on materials such as paper, cardboard or plastic with picture parts printed thereon and holes simply punched in the appropriate standard positions. It is a straightforward and inexpensive version which consists of layers of the same size and shape with the pattern and apertures portions variously arranged

within a standard framework.

Thus, in FIGS. 9 to 12, layers with component picture portions 43 from part (a) on side A may each have component picture portions 43 from part (c) (for example) on the rear, and layers with component picture portions 43 from part (c) on side A would have part (a) component picture portions 43 on side B. Note the distinction of side A and B is for illustrative purposes only. Thus, in a three layer puzzle, for a particular part 32 of the solution picture, there would be 6 possible layers from which to choose 3 to form the part of the overall picture in question.

When one part is formed, the other three layers must of necessity be able to be combined to form the other part.

The pattern and aperture portions on the layers are configured such that, as illustrated in FIG. 10, a correct solution of the image in part (a) is the overlay of the displayed side of each of layers (i),(ii) and (iii), and similarly the correct solution for part (f) is the correct combination of layers (xvi), (xvii) and (xviii). However, in addition it is possible for one or more alternative combinations of 3 of the 6 layers, for example, (i),(ii) and the reverse side of (xiv), to produce the image in one of the parts. Of course, no combination of other available layers can now fully form the image in part (f), because of "chain reactions" of deficiency through the other parts.

Thus, the user may choose the wrong combination of layers and sides for one part of the puzzle and believe that it has been solved, only to find later on that another part cannot be solved without destroying work already done. Each set of layers in Fig. 10 incorporates this feature.

Whilst capable of being realised using layers made of transparent material and also transparent inks, the present invention, in its preferred embodiments, makes use of opaque patterned portions containing the full image rather than component images for a particular area of pattern, and aperture portions within the bounds of each layer variously arranged within a constant framework on all layers (which can also be standardised between puzzles). This enables puzzles of many differing levels of complexity and difficulty to be produced within standard frameworks using similarly sized and

shaped layers, which can be made of a wide range of possible materials.

It will of course be realised that while the above has been given by way of illustrative example of this invention, all such and other modifications and variations thereto as would be apparent to persons skilled in the art are deemed to fall within the broad scope and ambit of this invention as defined in the appended claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. Puzzle apparatus including a plurality of puzzle elements each having a plurality of symmetrically arranged segments whereby the elements may be selectively grouped with the segments aligned and characterised in that each element has an array of indicia in respective ones of said segments whereby at least one grouping of elements may be effected with the indicia cooperating to form a predetermined pattern.

2. Puzzle apparatus in accordance with Claim 1, wherein said plurality of puzzle elements comprise substantially two dimensional layers.

3. Puzzle apparatus in accordance with Claim 2, wherein said layers are of a shape selected from circular or polygonal plane layers, or non-planar layers having spherical, semi-spherical, convex or concave surfaces.

4. Puzzle apparatus in accordance with any one of the preceding Claims, wherein said symmetrically arranged segments are of identical shape and size.

5. Puzzle apparatus in accordance with Claim 4, wherein said segments are of the same shape as the layers upon which they appear such that when two or more layers are overlaid, corresponding segments on the respective layers coincide.

6. Puzzle apparatus in accordance with Claim 5, wherein said indicia are not contiguous, such that a framework is defined on said layers between said indicia.

7. Puzzle apparatus in accordance with any one of the preceding Claims, wherein said indicia are selected from substantially opaque, pattern generating portions and substantially transparent look-through portions.

8. Puzzle apparatus in accordance with Claim 7, wherein said look-through portions comprise apertures provided through said puzzle layers.

9. Puzzle apparatus in accordance with any one of Claims 2 to 8, wherein said indicia are provided on both major surfaces of at least one of said puzzle layers.

10. Puzzle apparatus in accordance with any one of the preceding Claims, wherein the number of puzzle layers ranges from 3 to 10.

11. Puzzle apparatus in accordance with any one of the preceding Claims, wherein said puzzle elements in assembly form a puzzle stack, there being provided at least one other puzzle stack adapted to fit adjacent to the first stack to yield a predetermined pattern which is contiguous over the stacks.

12. Puzzle apparatus in accordance with Claim 11, wherein adjacent stacks are adapted to interlock with each other.

13. Puzzle apparatus in accordance with any one of the preceding Claims, wherein said predetermined pattern comprises a predetermined pattern of coloured indicia.

14. Puzzle apparatus in accordance with any one of Claims 1 to 12, wherein said predetermined pattern comprises a pictorial image.

15. Puzzle apparatus including a plurality of sets of from 3 to 10 puzzle layers, each puzzle layer having a plurality of symmetrically arranged segments whereby the layers of each set may be selectively grouped with the segments aligned, and characterised in that each layer has an array of indicia in respective ones of said segments whereby at least one stack formed of the layers of each set may be effected with the indicia cooperating to form part of a predetermined pattern, and wherein the respective sets may be assembled together to form the whole of the predetermined pattern.

16. A method for producing a puzzle of the type claimed

in any one of the preceding Claims and including the steps of:-
selecting a puzzle solution;
selecting a desired shape and number of puzzle elements between 3 and 10 inclusive;
dividing said elements into an array of segments each having the same shape as said elements;
providing a look-through aperture through each of a random selection of segments of a first element;
providing those segments not occupied by said apertures with a corresponding portion of the pattern of said solution;
overlaying said first element over said solution, and
progressively assigning segments on successive elements to contain patterned portions or apertures such that, in assembly, said elements display said solution pattern.

17. Puzzle apparatus substantially as hereinbefore defined, with reference to the accompanying drawings.

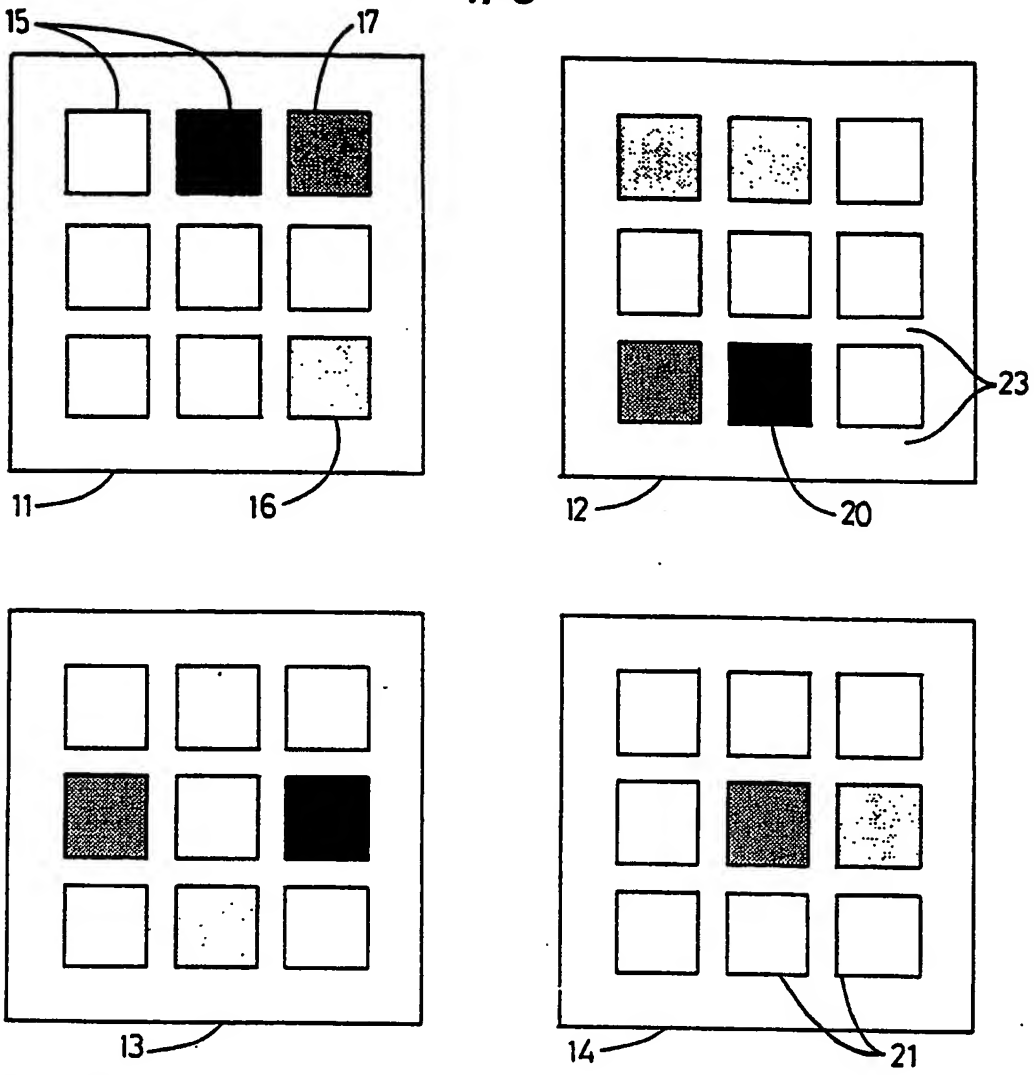


fig. 1

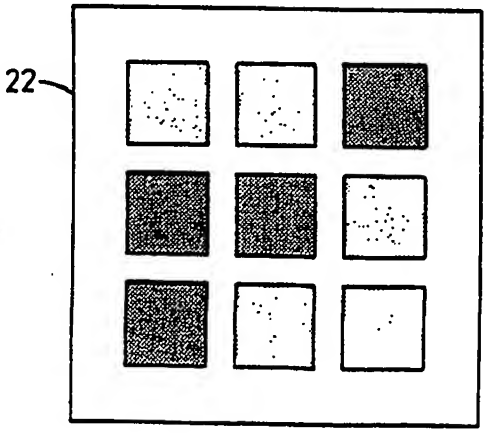


fig. 2

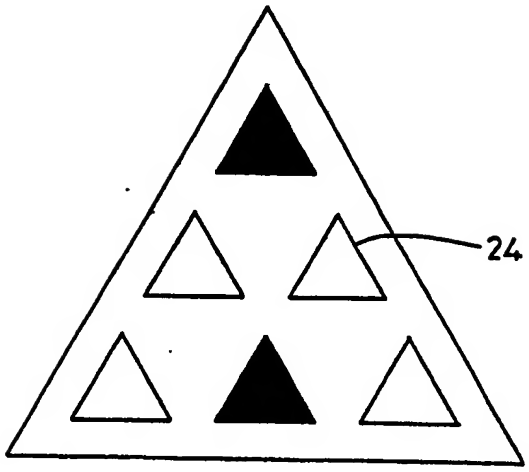


fig. 3

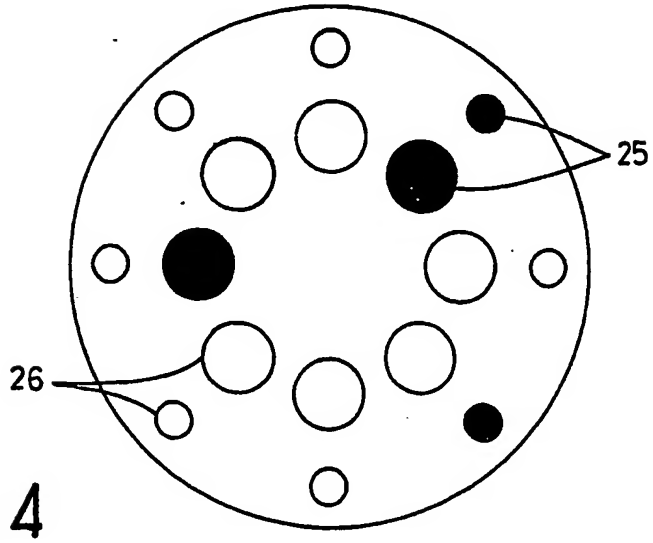


fig. 4

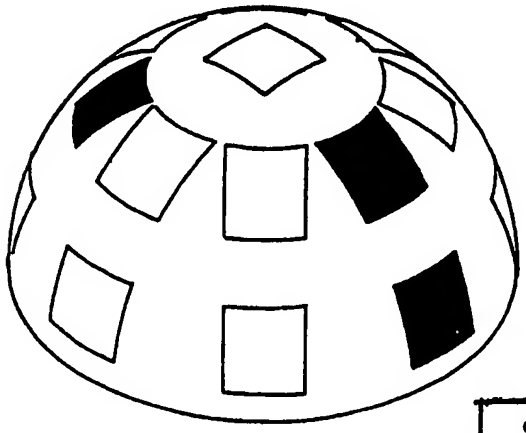


fig. 5

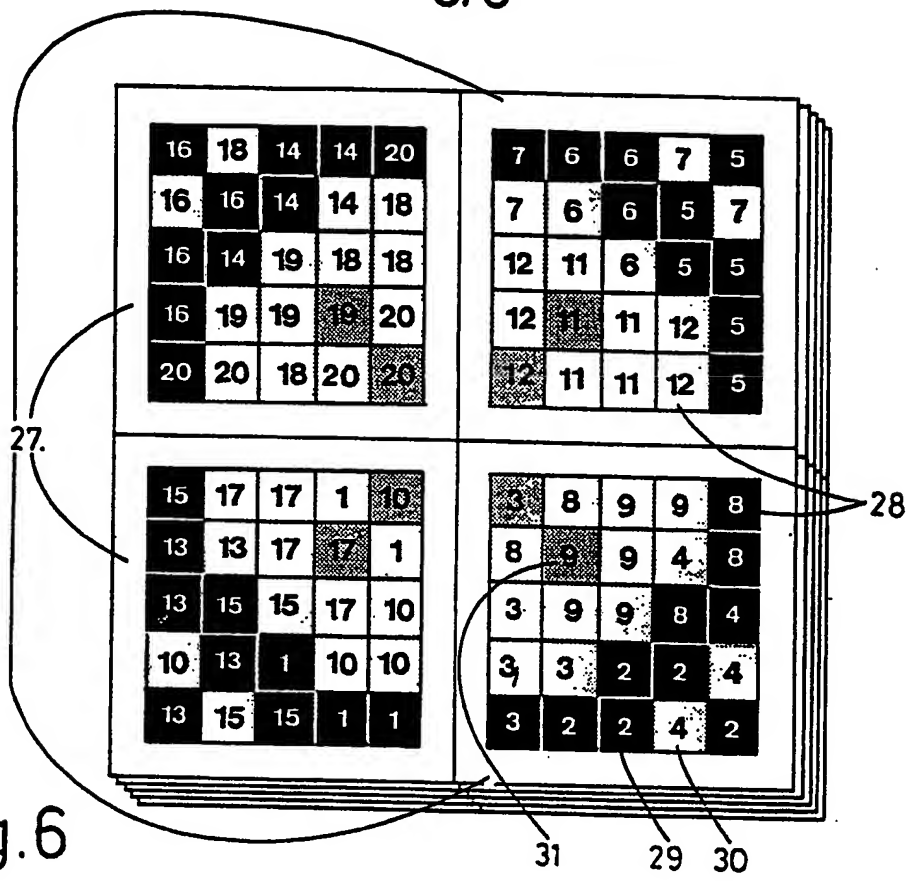


fig.6

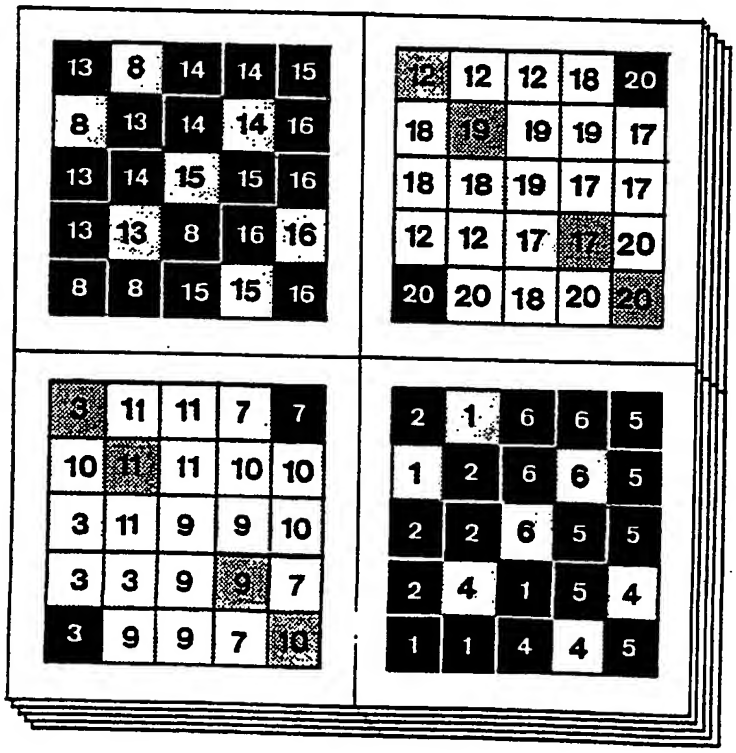


fig.7

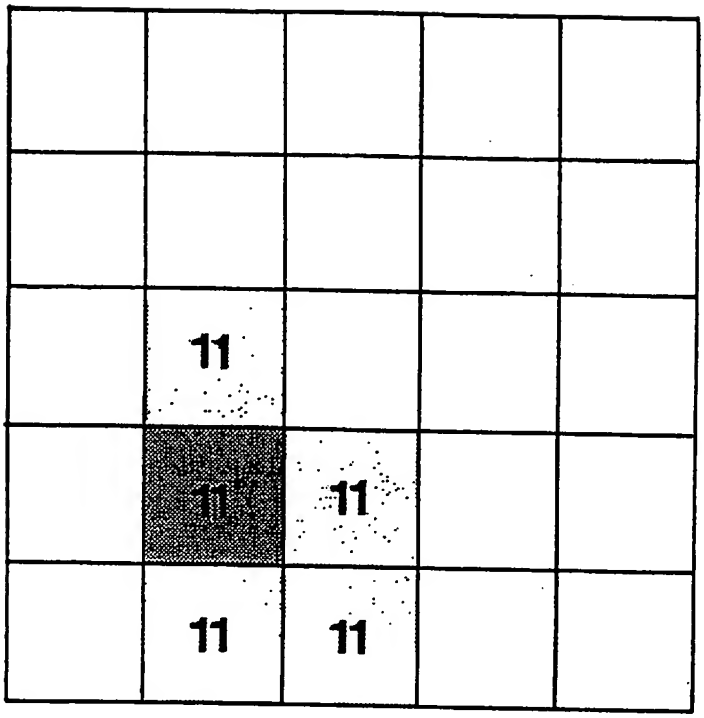


fig.8

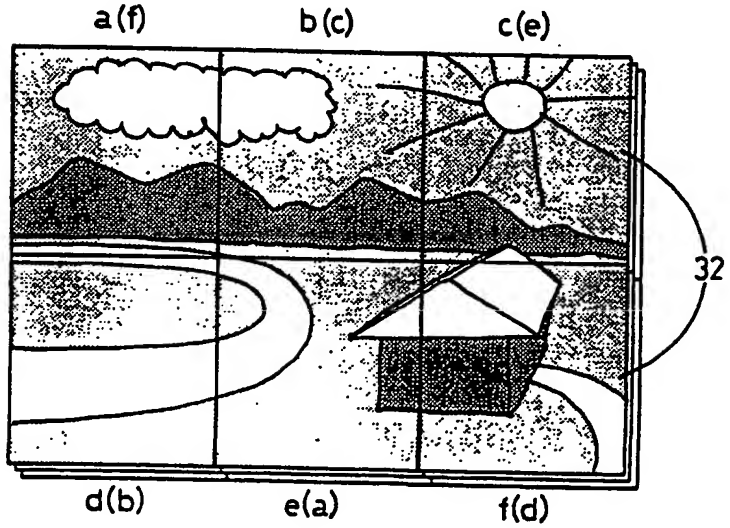
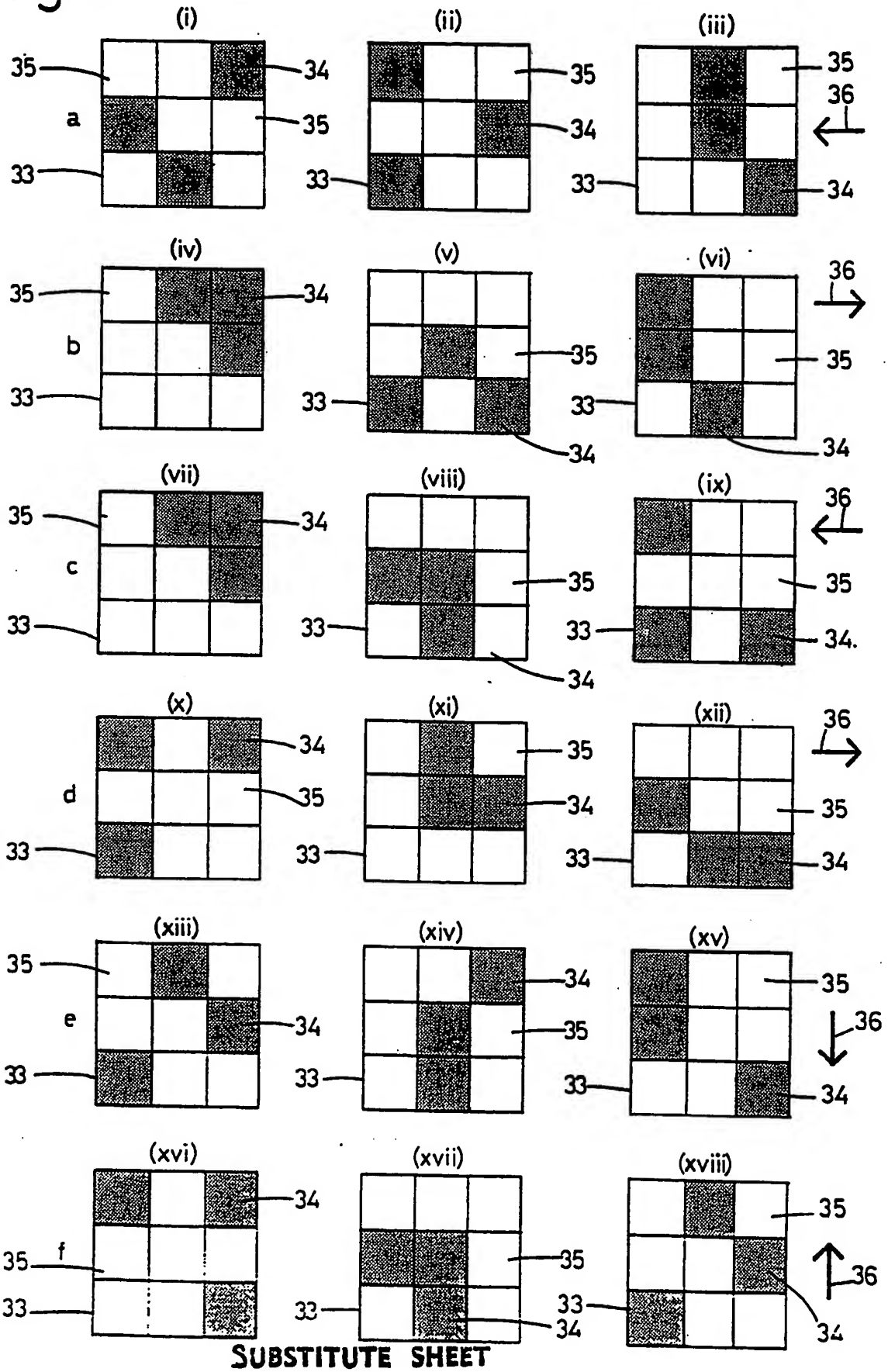


fig.9

fig.10

5/6


(i)
(ii)
(iii)
(iv)
(v)
(vi)
(vii)
(viii)
(ix)
(x)
(xi)
(xii)
(xiii)
(xiv)
(xv)
(xvi)
(xvii)
(xviii)
a
b
c
d
e
f
33
34
35
36

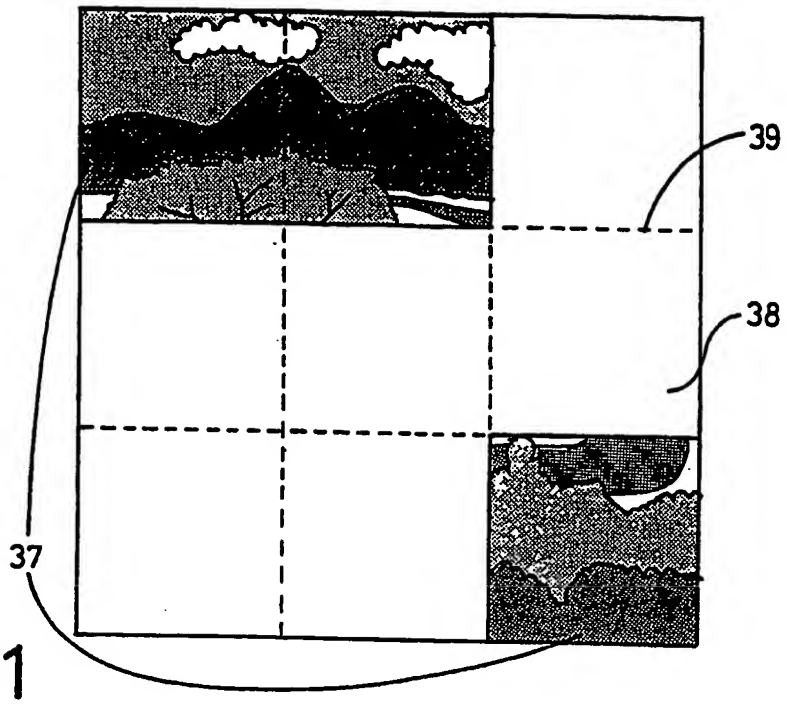


fig.11

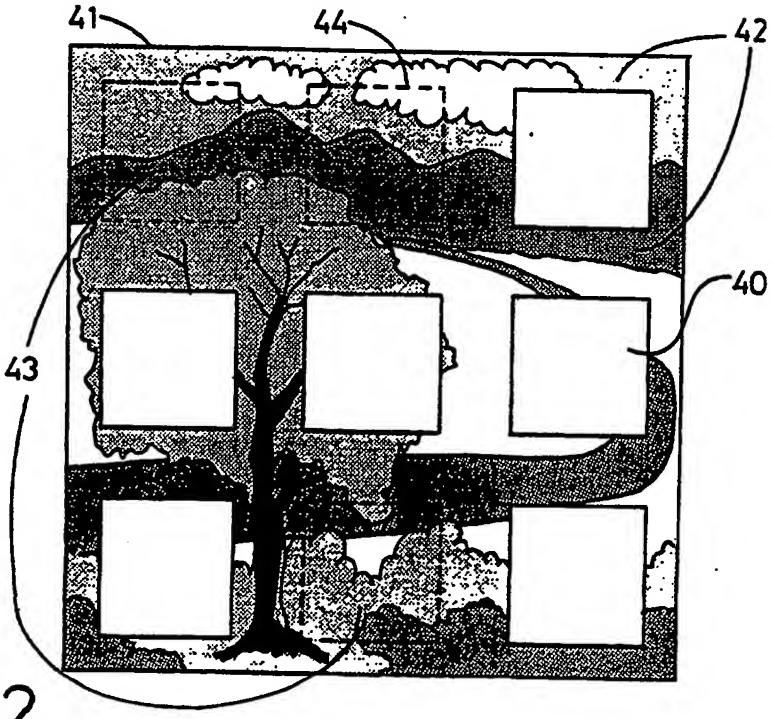


fig.12

INTERNATIONAL SEARCH REPORT

International Application No. PCT/AU 90/00297

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) 6

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[5] A63F 9/12

II. FIELDS SEARCHED

Minimum Documentation Searched 7

Classification System	Classification Symbols
IPC	A63F 9/06, 9/08, 9/12

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched 8

AU: IPC as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT 9

Category*	Citation of Document, 11 with indication, where appropriate, of the relevant passages 12	Relevant to Claim No 13
X Y	GB,A, 743749 (PHILLIPS) 25 January 1956 (25.01.56) See page 2 lines 86 to 96	(1-5,7,10-15) (8,9)
X Y	US,A, 4605231 (RICHMAN) 12 August 1986 (12.08.86)	(1-5,7,10,11,13-15) (8,9,12)
X	US,A, 3892411 (HIGH) 1 July 1975 (01.07.75)	(1-7,10,13,15)
X	EP,A, 87538 (VIDON) 7 September 1983 (07.09.83)	(1-8,13,15)
X Y	US,A, 4373730 (KOLTZ) 15 February 1983 (15.02.83) See column 5 lines 49 to 53	(1-4,7,8,10,13,14) (16)

CONTINUED

* Special categories of cited documents: 10

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
3 September 1990 (03.09.90)	10 September 1990
International Searching Authority	Signature of Authorized Officer
Australian Patent Office	M.A. SMITH

Form PCT/ISA/210 (second sheet) (January 1985)

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category*	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
Y	US,A, 4815742 (AUGUSTINE) 28 March 1989 (28.03.89)	(1-3, 7-16)
Y	US,A, 4362301 (DUVEYOUNG) 7 December 1982 (07.12.82)	(2-7,9,10,13)